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# PATENT SPECIFICATION

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## COMPLETE SPECIFICATION

### Improvements in or relating to Apparatus for Separating Stacked Flat Articles

I, HER MAJESTY'S POSTMASTER GENERAL, a British subject, of the General Post Office, London, E.C.2, do hereby declare the invention, for which I pray that a patent may be granted to me and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to apparatus for separating stacked flat articles and is particularly although not exclusively concerned with apparatus for separating postal letters one by one from a stack or pile of letters.

In the mechanised sorting of postal letters it is desirable that letters from a stack to be sorted shall be separated individually at time intervals determined by the rate of sorting and fed to a sorter who should be able to start or stop the supply of separated letters at will.

The object of the present invention is to provide apparatus possessing the desired features and which is capable of continuous operation over long periods. A further object of the invention is to provide letter separating apparatus which will expedite the sorting of letters.

According to the present invention, apparatus for separating flat articles from a stack of articles having the same or differing superficial areas comprises an inclined platform adapted to support the stack thereon, means for moving the said platform upwardly in a direction normal thereto, an upwardly extending article supporting member lying adjacent the path of movement of the lower edge of the platform so that the articles rest edgewise against the said supporting member which member is movable upwardly concomitantly with upward movement of the platform whereby sliding friction between the articles and the supporting member is substantially eliminated, and a pneumatic pick-up member adapted to be moved into contact with, and to pick up by suction, the topmost article of the

stack and means for positively removing the article from the pick up member and transferring the article to further article-handling means.

According to a feature of the invention, the said platform moving means is controlled by a photoelectric device responsive to the presence of an article to be separated, the control being such that the article in the stack nearest to the pick-up member is maintained substantially at the pick-up level until engaged and removed from the stack by the pneumatic pick-up member.

According to a further feature of the invention, the pick-up suction referred to is caused to cease simultaneously with the removal of the article from the pick-up device by, for example, means operated automatically when the pick-up device reaches the means for removing the article therefrom.

In carrying the invention into effect, the pick-up member may be constituted by a rigid hollow tube, one end of which carries a suction head the other being connected to means, such as a motor driven air pump, for producing a partial vacuum. The rigid tube may be carried by articulated members operated by power means to produce the desired motion of the tube and valve means, e.g., a rotary air valve mounted on a power-driven shaft, arranged to connect the suction head to the atmosphere and to seal it off from the pump when the suction head approaches the means for removing the article; the suction head being cut off from atmosphere and again connected to the pump by the rotary valve when the suction head next contacts an article to be separated.

The suction head may conveniently be constituted by a resilient collapsible sheath provided with a flange or boss at its one end and a rigid cheek at the other end. The flange or boss facilitates connection of the suction

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head to a flange at the lower end of the hollow tube and the rigid cheek is shaped to correspond with the surfaces of articles to be separated, the resilience of the collapsible sheath facilitating close engagement of the face of the cheek with the articles. Alternatively the flange or boss may be omitted and the collapsible sheath clamped over the end of the rigid tube.

In the application of the invention to the separation of postal letters, a three sided trough inclined, e.g., at or about  $30^\circ$ , to the vertical may be provided and a stack of letters to be separated placed in the trough upon a movable platform arranged to be mechanically raised to feed the stack of letters towards the pick-up member. The means for moving the platform may be controlled by a photo electric system for co-operation with the letters themselves.

According to a further feature of the invention, jets of air may be caused to impinge upon the edges of those articles or letters to be separated which are adjacent the pick-up member and preferably the velocity of the air jets is such that the article or letter immediately adjacent the pick-up member is rendered almost air borne, thus effecting a degree of separation of that article or letter from the stack before it is engaged by the pick-up member.

In order that the invention may be clearly understood and readily carried into effect, one practical form of postal letter separating apparatus constructed and arranged to operate in accordance with the invention will hereinafter be described by way of example and with reference to the accompanying drawings in which:—

Fig. 1 is a side elevational view of the apparatus;

Fig. 2 is a front elevational view thereof;

Fig. 3 is a fragmentary elevational view of the movable letter-supporting platform and associated driving means of the apparatus, drawn to a larger scale;

Fig. 4 is a plan view thereof;

Fig. 5 is a front elevation of the associated driving and controlling means of the pick-up member, drawn to a larger scale;

Fig. 6 is a part sectional elevation looking in the direction of the arrow VI (Fig. 5); and showing the pick-up member holding a letter and located in the rest position;

Fig. 7 is a view similar to Fig. 6, but showing the pick-up member in a different operative position;

Fig. 8 is a sectional detail view of the air control valve forming part of the pick-up controlling means, the valve being shown in the open position;

Fig. 9 is a sectional view taken on line IX—IX of Fig. 8, but with the valve in the closed position; and

Figs. 10 and 11 are detailed views, drawn

to a larger scale, of the air jet arrangement associated with the pick-up member.

Referring to more particularly to Figs. 1 and 2 of the drawings, it will be seen that the component parts of the apparatus are supported upon an upwardly extending framework comprising a base 1 with vertical members 2 and longitudinals 3 inclined to the vertical to support the side walls of a three sided, box-shaped trough or guideway 4.

The three sided trough 4, the internal width of which is slightly greater than the length of the longest letter in a stack SL placed therein to be separated, is mounted in the framework below a pick-up means 5 (hereinafter more fully described) and is inclined at or about  $30^\circ$  to the vertical. The top end of the trough 4 is open for the passage of the pick-up means 5 and letters held thereby and the open longitudinal side of the trough faces outwards to facilitate placing the stack of letters SL upon a movable platform 6 which is extended transversely of the trough and supported so as to rise and fall longitudinally thereof.

The letters of the stack SL are previously arranged so that one long edge thereof extends across and lies adjacent the back of the trough and the rear edge of the movable platform 6 has attached thereto the lower end of a flexible band 7, e.g., a textile or rubber band, which extends upwardly and lies adjacent the path of movement of the lower rear edge 6 of the platform to form at the back of the trough an aligning supporting member for the rear longitudinal edges of the letters stacked on the platform 6.

The upper end of the flexible band 7 passes over a small pin or guide roller 8 and then winds around a spring loaded winding roller 9 in the manner of a spring blind so that the band moves with the platform and remains relatively stationary to the letter stack SL as the platform is raised and lowered, during which movements more or less of the upper part of the band is wound upon and unwound from the spring-loaded winding roller 9. The relatively stationary band 7 is provided to obviate the friction which would otherwise occur between the relatively moving trough back and rear longitudinal edges of the letters stacked therein and carried upwards by the moving platform which friction would be liable to cause tilting of the letters about their longitudinal axes and thus possibly result in an edge of a letter, instead of its face being presented to the pick-up means.

An electric driving motor 11, an electromagnetically operated clutch 12 and gear set 13 are mounted at the top of the framework to provide for the actuation of the pick-up means 5 comprising a pivotal rigid hollow tube 14 carrying a suction head 15 disposed in a vertical plane containing the central longitudinal axis of the trough 4, the hollow tube and suction head being shown in the rest

position in Figs. 1 and 6. As shown more clearly in Figs. 5, 6 and 7, the upper end of the hollow tube 14, hereinafter referred to as the pick-up arm, is clamped in a split block 16 fixed between the inner faces of a pair of upwardly extending arms 17 each of which carries upon its outer face a pair of anti-friction runners 18, 19, e.g., ball or roller bearings, which track in cam shaped guide slots 20 formed in the inner faces of a pair of guide plates 21 secured to cheek plates 22 which are mounted in mutually spaced parallel relation between the frame members 2 and 3.

The anti-friction bearings 18 are rotatably mounted upon the projecting outer ends of a gudgeon pin 24 which passes transversely through the arms 17 and serves pivotally to couple thereto the lower end of a connecting rod 25. The upper end of the connecting rod 25 is pivotally coupled to the crank of a cranked driving shaft 26 extending between the cheek plates and journaled in anti-friction bearings. One end of the driving shaft 26 is coupled to the motor 11 and gear set 13 through the electro-magnetic clutch 12 and pair of gear wheels 26a, the other end of the driving shaft is fixed or coupled to a rotor part of a rotary air control valve 27 (hereinafter more fully described).

The cam guided levers 17 are thus arranged to pivot about the axis of the gudgeon pin 24 and to move about this axis in accordance with the position of the anti-friction runners 18, 19 in the cam slots 20. Thus, as the cranked driving shaft 26 rotates, the pick-up arms and suction head will move from the rest position shown in full lines in Fig. 6 initially upwards and rearwards in a pivotal movement to the position shown in Fig. 7 to dispose of the letter carried by the suction head. Thereafter, the pick-up arm and suction head swing forwards and downwards to return through the rest position towards the lowermost position shown in chain dot outline in Fig. 6 to pick up the top letter of the stack SL and then again move upwards with the letter to reach the rest position shown in full lines in Fig. 6. The operative movements of the parts are hereinafter more fully described.

The upper end of the pick-up arm 14 has connected thereto one end of a flexible tube or hose 28 which is connected via the rotary air control valve 27 to the low pressure side of a motor driven air pump 29, mounted on the framework base 1, so that when the pump is operating suction is created in the suction head 14 by suction of air through the hollow pick-up arm 14 during the upward and backward letter-transferring movement of the pick-up arm.

The suction head 15, attached to the lower end of the pick-up arm 14, comprises a short tubular rubber body secured between an

upper flange or cheek plate 30 formed of metal and a lower cheek plate or suction pad 32. The upper flange or cheek plate 30 is secured to a flange 31 fixed to the lower end of the pick-up arm so that an aperture formed in the cheek plate registers with the bore of the pick-up arm. The lower cheek plate or suction pad 32, which may suitably be made of lightweight metal or fibre board for example, is substantially oval in shape and provided with a suction orifice 33 (or plurality of such suction orifices) registering with the bore of the tubular suction head, and has its forward end upwardly curved for a purpose referred to hereinafter.

Co-operating pairs of inversely rotating snatch rollers 34, 35 are mounted upon vertically spaced horizontal spindles 36, 37 disposed immediately behind the pick-up member 5, the spindle 37 and roller 35 being driven from another driving motor (not shown) and serving, in turn, to drive the roller 34 on spindle 36. The disposition of the co-operating pairs of snatch rollers is such that when a postal letter held by the suction head 15 is brought by the pick-up arm 14 from the top of the stack and presented for engagement by the rollers (as shown in Fig. 7), the letter will be withdrawn from the suction head by the snatch rollers and ejected on to a conveyor means or into a guideway (not shown) disposed behind the snatch rollers.

As shown in Figs. 5 and 6, the snatch roller spindle 36, extends between and is journaled in bearings slidably mounted in slots 71 formed in bearing plates 22a which may be fixed or adjustably secured to the cheek plates 22. The snatch rollers 34 are thus adapted to be displaced relatively to the associated snatch rollers 35 to accommodate postal letters of various thicknesses and are yieldingly maintained in contact with or operative relation to the co-operating rollers 35 by twist springs 72 mounted upon anchoring pins 73 and disposed so that the free longer arms thereof press upon the bearings of the spindle 36.

In order to facilitate the ready release of the letters from the suction head 15, the suction effect created by the air pump 29 is automatically controlled by the rotary valve means 27 coupled to the positively driven crank shaft 26.

As shown more clearly in Figs. 8 and 9, the rotary valve 27 comprises a hollow valve body 38 secured in an angularly adjustable manner by screws 38a to the framework of the apparatus and provided with air inlet and outlet ports 41, 42 respectively connected to the air tube or hose 28 leading to the pick-up arm and an air tube or hose 28a leading to the low pressure or suction side of the pump 29. A valve rotor 39 is mounted upon and driven by the crank shaft 26 so as to rotate

in the valve sleeve in co-axial relation thereto. The valve rotor 39 has a peripheral port or groove 40 which establishes communication between the ports 41, 42 to allow  
 5 air to be drawn from the pick-up arm and suction head into the pump when the suction head is required to pick up a letter, and to connect the port 41 to atmosphere through  
 10 passage 39a, when the rotor is turned to shut off the port 41 from port 42 during some part of each operative cycle.

The internal width of the guideway from about or just below the rest position of the pick-up means 5 up to and alongside the  
 15 snatch rollers is progressively increased to provide sufficient clearance for the outer end edges of postal letters which are eccentrically, i.e., not ideally placed in the stack SL so that they are passed from the top of the stack to  
 20 the snatch rollers without obstruction or diverting contact with the walls of the guideway.

The upwardly extending trough or guideway 4 is furnished with mechanism for raising  
 25 and lowering the letter-supporting platform 6 longitudinally of the trough. As shown in detail in Figs. 3 and 4, the platform 6 comprises a platform member 43 and front plate 44 mounted upon a framework 45 to which  
 30 is fixed one end of a hollow rod or tube 46 which extends through a longitudinal slot 4a formed in the bottom or back of the trough or guideway to provide a rigid support and attachment for the platform 6. The hollow rod  
 35 46 extends rearwards from the platform and trough and is rigidly fixed at its outer end to the front end of a rectangular frame or carriage 47.

The side members of the carriage 47 embrace a fixed upwardly extending flanged  
 40 guide pillar 48 and carry bearing brackets 49 for anti-friction thrust rollers or runners 50 which, together with transversely disposed anti-friction thrust rollers or runners 51  
 45 mounted upon the inner faces of the carriage side members, engage the flange surfaces of the guide pillar 48 and thus rigidly support the carriage whilst permitting it freely to travel up and down the fixed guide pillar.

The carriage 47 is also provided with guides 52 slidably to support and contain the  
 50 sections of a split threaded nut 53 which engages an upwardly extending lead or driving screw 54. The split nut sections 53 are coupled together by pairs of slotted  
 55 crossed links 55 which pivot at their longitudinal centre points about fixed pivots 56 located in a plane containing the longitudinal axis of the lead screw and thus ensure equal  
 60 and opposite parallel displacing movements of the split nut sections in relation to the axis of the lead screw. The lead screw 54 is mounted in fixed bearings so as to lie parallel to the back and sides of the trough or guide-  
 65 way and extends along substantially the

entire length thereof.

The lead screw 54 is rotated by an electric motor 57 through a gear set 58 mounted in the bottom part of the framework  
 70 of the apparatus and thus, when the lead screw is driven and rotated in the appropriate direction, the split nut whilst maintained in engagement therewith is constrained to travel  
 75 up the lead screw and carries the platform 6 therewith. The driving motor and gear set are preferably coupled to the lead screw through a mechanical fuse arrangement, e.g., a yielding friction clutch, which will prevent  
 80 inadvertent over-run of the upwardly driven platform such as might occur in the event of failure or wrong setting of automatic control means.

One of the sections of the split nut 53 is connected to the outer end of a threaded rod  
 85 59 which passes through the hollow rod or tube 46 and slides in suitable guideways formed in the upright members 60 of the platform framework 45. The rod 59 carries, intermediate its ends, a helical compression  
 90 spring 61 which re-acts between the inner face of one of the framework uprights 60 and a thrust collar 62 adjustably located upon the rod 59. The thrust of the spring 61 is thus transmitted by the rod 59 yieldingly to maintain the split nut in driving engagement with  
 95 the lead screw. The inner end of the screw 59 is connected to the shorter arm of a belt crank lever 63 fulcrumed upon a horizontal pivot 64 fixed beneath the platform member 43 and screw 59. The longer arm of the bell  
 100 crank lever 63 carries a thumbpiece 65 projecting outwards from the front wall 44 of the platform and upwardly inclined from a supporting handle or grip 66 which is fixed to and also projects outwards from the front  
 105 wall of the platform. The last described arrangement is such that by depressing the pivotal thumbpiece 65 towards the fixed handle or grip 66 and thereby rocking the bell  
 110 crank 63 in clockwise direction (as viewed in Fig. 3) the rod 59 is drawn forwards against the compression of the loading spring 61, thereby drawing the split nut sections 53  
 115 apart and releasing them from driving engagement with the lead screw. In this manner, the platform 6 and driving carriage 47 can be decoupled from the mechanical platform  
 120 drive and lowered by hand to the bottom of the trough or guideway or any intermediate position as required, and likewise raised as required, the movement of the platform being  
 125 controlled by the hand grasping the handle or grip 66 and thumbpiece 65.

At the upper part of the trough or guideway 4 there is arranged an optical system comprising a source of projected light 67, a light-  
 130 reflecting surface 68 and a photo-electric cell 69. The optical system is adapted to project a flat ribbon of light across the width of the trough or guideway in the path of the stack

of letters as the latter is elevated by the upwardly driven platform and the photo-electric cell 69 upon which the uninterrupted ribbon of light falls is connected in an electronic amplifier circuit arranged to energise relay means which control the switch circuit of the electric motor 57 driving the lead screw 54.

An arrangement of air jet orifices 70, as shown in detail in Figs. 10 and 11 may also be provided at the upper part of the trough and connected by an air supply tube or hose 74 to the high pressure side of the air pump 29 or to a separate air pump (not shown) for the purpose of directing towards the ends of the letters at the top of the stack streams of air which cause the topmost letter to be at least partially airborne and so to separate it from the next letter. The inwardly extending passages 70a leading to the air jet orifices 70 are downwardly inclined, e.g., at an angle of approximately 15° to the horizontal as shown in Fig. 11, so that the jets of air travel downwards and thus impinge upon the edges of the stacked letters thereby opposing the upward movement of the letters which lie beneath the uppermost letter engaged by the suction head. Any tendency towards the picking up by the suction head of more than one letter at a time is thus eliminated or reduced.

In the operation of the apparatus described above, assuming that a stack of letters SL has been placed upon the platform 6 as shown in Figs. 1 and 2, the motor 57 driving the platform 6 is started by switching on the light beam from the source 67 and thus operating the motor switch through the photo electric cell 69 and relay means as above mentioned. It will be assumed further that the driving motor 11 has been started to set the pick-up arm 14 and suction head 15 in motion when the electro-magnetic clutch 12 is engaged; that the air evacuating pump 29 (and separate air pump, if provided) is or are running to operate the suction and air jet systems and that the photo electric cell and associated electronic amplifying systems are energised.

The platform 6 and stack of letters is elevated until the topmost letter intercepts the light beam of the optical system whereupon the photo electric cell permits the relay means to switch off the platform driving motor 57 and the raising of the letter stack ceases. At this time the topmost letter is within the area swept by the streams of air from the air jets 70 and becomes more or less airborne and separated from the remainder of the stack. The pick-up arm 14 is moved downwards at this juncture through the full line rest position shown in Fig. 6 to contact the suction head 15 with the airborne topmost letter which is readily picked up by the suction head and retained thereby while the suction head is returned to the rest position and held therein and during the subsequent

upward and rearward movement of the pick-up arm and suction head to the position shown in Fig. 7.

Reference to Figs. 6 and 7 will make it clear that the path of the rear edge of the letter thus lifted from the top of the stack is closely controlled by the crank, lever and cam groove system shown therein in such a manner that as the crank shaft 26 and connecting rod 25 move upwards from the bottom dead centre position shown in chain dot outline in Fig. 6 to the rest position shown in full lines in Fig. 6 the rear edge of the topmost letter is moved upwards parallel to the rear surface of the trough for a short distance whilst separation of the letter from the stack is effected or completed, and the letter then moved slightly forward (as the rollers 19 commenced to track the upper curved parts 20a of the cam grooves 20) to clear the rear edge of the letter from the top rear edge of the trough. The magnetic clutch is then disengaged to halt the suction head and letter held thereby in the rest position. Thereafter, when the magnetic clutch is again engaged the upward and rearward movement of the suction head and letter held thereby is effected (as the rollers 19 continue to track the curved parts 20a of the cam grooves 20) and the arms 17 pivot about the axis of the rollers 18 as shown in Fig. 7 to feed the rear edge of the letter into the bight of the snatch rollers 34, 35. In this arrangement, it is preferred to rotate the crank shaft 26 at a constant speed and to keep the velocity of separation as low as possible to improve reliability, while making the transit movements comparatively fast.

At the time when the letter is engaged by the snatch rollers the crank shaft 26 has rotated the valve rotor 39 sufficiently to cut off the suction head from the air pump 29 and vent the pick-up arm to atmosphere thus destroying the suction which was causing the letter to adhere to the suction head and thereby facilitating the transfer of the letter to the snatch rollers.

The letter thus engaged by the snatch rollers is disposed of in any desired manner, e.g., as indicated above, and in particular applications of the apparatus described the separated letters may be passed to the viewing position of a coding operator prior to automatic sorting.

The removal of the topmost letter of the stack by the pick-up arm allows the light beam which was intercepted thereby once more to impinge upon the photo-electric cell so as to effect completion of the energising circuit of the platform driving motor, with the result that the platform is again raised until the next topmost letter of the stack intercepts the beam with consequential repeated cessation of the platform movement and a further operative cycle of movement of the pick-up arm and suction head.

When all the letters of the stack have thus been removed one by one by the pick-up arm the empty platform reaches the top of its travel and itself interrupts the light beam and causes the platform drive to cease. To re-fill the trough with a stack of letters, it is necessary first to part the split nut sections by manipulation of the handle 65 and associated mechanism and then to bring the platform down under hand control exerted upon the handle 66. The platform may thus be brought down to its lowest position at the bottom of the trough or to any other intermediate position, according to the height of the fresh stack of letters to be placed therein, and located in the lowered position by release of the control handle 65 to permit the spring-urged re-engagement of the split nut sections, with the lead screw, thus re-setting the platform ready to commence its next upward drive.

The light beam may be switched off from its source or masked whilst the platform is re-filled or left idle, and the platform drive will not then re-commence until the light beam is again switched on or un-masked and this may, of course, be done by the person who reloads the trough with a fresh stack of letters to be separated.

The collapsible nature of the bellows-like suction head provides a degree of flexibility in the effective length of the pick-up arm. Thus if the top letter, or that portion of it with which the suction head comes into contact, is below the optimum position but not more than the depth of the suction head below that position, the suction head is driven down on to the letter. If on the other hand, the letter is at the optimum level, the bellows collapse on continued downward movement of the pick-up arm and so prevents the stack from being compressed appreciably. This collapsing is brought about by the hole in the lower cheek of the suction head becoming sealed by the face of the letter, resulting in a decrease of pressure inside the bellows. The air jets are thus enabled to fulfil their function of preventing the formation of any residual vacuum between the top letter and that immediately adjacent it, or alternatively to break any vacuum as soon as it forms. Obviously, the suction head may be made telescopic instead of in the form of a collapsible bellows.

Reference has been made earlier to the turning up of the forward end of the lower cheek plate or suction pad 32 of the suction head and this construction is adopted because, when a stack of letters includes envelopes of the open window type for example, it has been found that the suction head may be operative upon the contents of the envelope exposed through the window and not upon the envelope itself. In consequence, when the letter is withdrawn by the snatch

rollers the edge of the window is apt to be caught by the cheek of the suction head if the cheek is quite flat. Accordingly, the front portion is turned up and the undesirable damage to letters and probable consequential interruption of the functions of the apparatus which may otherwise occur is avoided.

It will be understood that although particular forms of construction of the various component parts of the apparatus have been described, modifications and alternative constructions within the scope of the invention may be adopted. Thus for example the means described for driving the letter platform may be modified by providing more than one fixed independent guide for the platform.

In one application of the apparatus described the operation of the electro-magnetically operated clutch 12 to set in motion the pick up arm 14, is effected by an electrical impulse received every time an operator, or the operation of a sorting equipment, disposes of a letter which has been separated from a stack of letters by the apparatus hereinbefore described.

The description given is of a single stack or trough of letters but in another form of the invention two or more similar stacks are placed side-by-side feeding into a common conveyor and the stacks are used in any order as desired. This arrangement provides increased storage capacity.

Alternatively to the split nut arrangement for manually lowering the raised letter-supporting platform may be positively driven downwards by a reversed drive but this will necessitate the provision of a reversible platform driving motor and manual control switch.

What I claim is:—

1. Apparatus for separating individual component articles from a stack of flat articles having the same or differing superficial areas, comprising an inclined platform adapted to support the stack thereon, means for moving the said platform upwardly in a direction normal thereto, an upwardly extending article supporting member lying adjacent the path of movement of the lower edge of the platform so that the articles rest edgewise against the said supporting member which member is movable upwardly concomitantly with upward movement of the platform whereby sliding friction between the articles and the supporting member is substantially eliminated, and a pneumatic pick-up member adapted to be moved into contact with, and to pick-up by suction, the topmost article of the stack and means for positively removing the article from the pick-up member and transferring the article to further article-handling means.

2. Apparatus as claimed in claim 1 wherein the said supporting member forms one wall of an upwardly inclined trough or guideway adapted to receive the stack of articles and along which the said platform moves, the said

pick-up member being positioned adjacent the upper end of the said trough or guideway.

3. Apparatus as claimed in claim 1 or 2 wherein the said supporting member comprises a flexible band secured at its lower end to the lower edge of the platform and at its upper end to a roller upon which the band is wound as the platform moves upwardly.

4. Apparatus as claimed in claim 3 wherein the said roller is spring loaded to wind the band thereon as the platform is moved upwardly.

5. Apparatus as claimed in claim 2, 3 or 4, wherein the top of the trough or guideway is left open for the passage of the pick-up member and flat article adhering thereto, and wherein co-operating snatch rolls are disposed adjacent the path of movement of the pick-up member so that the article carried thereby is presented to and engaged between the snatch rollers and thereby transferred from the pick-up means to the said further handling means.

6. Apparatus as claimed in claim 2, 3, 4 or 5, wherein the movable platform is raised in the trough or guideway by power driving means including an electric driving motor which is controlled by relay operated switch means.

7. Apparatus as claimed in claim 6 wherein the said relay operated switch means includes control means effective upon correct positioning of the topmost article of the stack at the required height for removal by the pneumatic pick-up, to halt the upward movement of the platform until the said article is removed from the stack.

8. Apparatus as claimed in claim 7, wherein the said control means comprises an optical system arranged to project a band of light across the upper part of the trough or guideway and path of the rising stack of articles on to photo electric cell means connected in an amplifier circuit governing the function of the switch operating relay so that the driving motor is operated to raise the platform and stack of articles supported thereon until the topmost article of the stack interrupts the projected band of light whereupon the relay functions to switch off the motor and halt the upward movement of the platform and stack until the topmost article is removed from the stack and ceases to interrupt the band of light.

9. Apparatus as claimed in claim 6, 7 or 8

wherein the movable platform is coupled to the driving motor through releasable driving means and manual control means are provided for manipulating the driving means so that the raised platform can be de-coupled from the driving means and lowered and thereupon again coupled to the said driving means for further stack-raising displacement.

10. Apparatus as claimed in claim 9, wherein the releasable driving means is adapted to locate the platform in any desired position intermediate the ends of the trough or guideway when manipulated to re-couple the power driving means to the platform.

11. Apparatus as claimed in any of the preceding claims 6—10, wherein the platform is rigidly connected to a carriage adapted to rise and fall in fixed runways and carrying a threaded split nut coupling adapted drivingly to engage a rotatable lead screw which is rotated by the electric driving motor, and wherein the sections of the split nut coupling are yieldingly maintained in driving engagement with the lead screw by spring means and parted by manually operated lever means to disengage from the lead screw.

12. Apparatus as claimed in claim 11, wherein the driving motor is coupled to the lead screw by a mechanical fuse arrangement e.g. a slipping clutch means to prevent inadvertent over-run of the platform due to failure or faulty setting of automatic control means.

13. Apparatus as claimed in any of the preceding claims, wherein the pick-up member is driven from power driving means through electromagnetic clutch means which is energised to set the pick-up member in motion by an electrical impulse received each time an operator, or the operation of sorting equipment, disposes of a flat article e.g. a letter which has been separated from a stack of letters by the apparatus herein claimed.

14. Apparatus for separating individual component articles from a stack of flat articles having the same or different superficial areas, substantially as hereinbefore described with reference to the accompanying drawings.

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#### PROVISIONAL SPECIFICATION

#### Improvements in or relating to Apparatus for Separating Stacked Flat Articles

I, HER MAJESTY'S POSTMASTER GENERAL, a British subject, of the General Post Office, London, E.C.2, do hereby declare this invention to be described in the following statement:—

This invention relates to apparatus for separating stacked flat articles and is particularly although not exclusively concerned with apparatus for separating postal letters one by one from a stack or pile of letters.



In the mechanised sorting of postal letters it is desirable that letters from a stack to be sorted shall be separated individually at time intervals determined by the rate of sorting and fed to a sorter who should be able to start or stop the supply of separated letters at will.

The object of the present invention is to provide apparatus possessing the desired features and which is capable of continuous operation over long periods. A further object of the invention is to provide letter separating apparatus which will expedite the sorting of letters.

According to the present invention, apparatus for separating flat articles from a stack of articles having the same or differing superficial areas comprising a pneumatic pick-up member which is moved into contact with and picks up by suction an article to be separated from the stack and is then moved into a position adjacent means for positively removing the article from the pick-up member, the articles being so disposed in relation to the pick-up member that the area engaged by the pick-up member is common to all the articles.

According to a feature of the invention, means are provided for moving the stacked articles towards the pick-up member, said means being controlled by a photo electric device responsive to the presence of an article to be separated, the control being such that the article in the stack nearest to the pick-up member is maintained in the pick-up position.

According to a further feature of the invention, the suction referred to is caused to cease simultaneously with the removal of the article from the pick-up device by, for example, means operated automatically when the pick-up device reaches the means for removing the article therefrom.

In a particular form of apparatus embodying the invention, the pick-up member is constituted by a rigid hollow tube, one end of which carries a suction head the other being connected to means, such as a motor driven exhaust pump for producing a partial vacuum. The rigid tube is carried by articulated members operated by power means to produce the desired motion of the tube and a valve disposed on the tube is operated by a member carried by the tube and arranged to engage a fixed portion of the apparatus, to relieve the partial vacuum and allow the pressure within the end of the pick-up member to rise when the suction head approaches the means for removing the article.

The suction head is preferably constituted by a resilient collapsible sheath provided with a rigid cheek at each end. One of the cheeks facilitates rigid connection of the suction head to the hollow tube and the other is shaped to correspond with the surfaces of articles to be separated, the resilience of the collapsible sheath facilitating close engagement of the face of the cheek with the articles.

In the application of the invention to the separation of postal letters, a three sided trough inclined at or about  $30^\circ$  to the vertical is provided and a stack of letters to be separated is placed in the trough above a movable platform arranged to feed the stack of letters towards the pick-up member. The means for moving the platform are controlled by a photo electric system for co-operation with the letters themselves.

According to a further feature of the invention, jets of air are caused to impinge upon the edges of those articles or letters to be separated which are adjacent the pick-up member and preferably the velocity of the air jets is such that the article or letter immediately adjacent the pick-up member is rendered almost air borne, thus effecting a degree of separation of that article or letter from the stack before it is engaged by the pick-up member.

In order that the nature of the invention may be more clearly understood, one form of postal letter separating apparatus constructed and arranged to operate in accordance therewith will now be more fully described by way of example.

The component parts of the apparatus are supported on a vertical framework. A driving motor, a solenoid operated clutch and gears are mounted at the top of the framework and provide for the desired movement of a pivoted rigid hollow tube which, in its rest position is slightly inclined to the vertical. The tube which, for convenience, will be referred to as the pick-up arm, is supported by articulated levers operated by the driving motor to move the pick-up arm from the rest position initially backwards to a predetermined maximum then forwards and downwards to a predetermined maximum, followed by retraction upwardly and rearwardly to the rest position, the cycle of movement being repeated.

The upper end of the pick-up arm has connected to it one end of a flexible tube, the other end of which is connected to the low pressure side of a motor driven pump mounted on the framework so that when the pump is operating, suction is created through the pick-up arm. The lower end of the pick-up arm has attached to it a suction head constituted by a short rubber tube secured between two metal end cheeks, the upper of which is circular and provides means for attachment of the head to the pick-up arm. Each cheek is formed with an aperture to register with the hollow pick-up arm and the lower cheek, which is substantially oval in shape and has its forward end turned up for a purpose to be referred to later.

Immediately behind the suction head when in its rest position driven snatch rollers are mounted on vertically spaced horizontal spindles. The disposition of the snatch rollers is such that when a postal letter held by the

suction head is brought by the pick-up arm from the rest position towards them, the rollers will withdraw the letter from the suction head and eject it onto a conveyor or into a guideway disposed behind the rollers.

In order to facilitate quick release of the letter from the suction head the suction action is broken by a valve disposed on the pick-up arm and operated by a spring loaded bar which normally holds the valve shut and is mounted transversely on the pick-up arm. The spring loaded bar is provided at each end with adjustable screws which pass through the bar at right angles and abut against the framework of the apparatus when the pick-arm approaches the snatch rollers. The valve is opened as the engagement of the screws with the framework overcomes the spring loading on the bar and the suction is broken. It is restored immediately the pick-up arm moves forwards as it continues its cycle of movement.

A three sided box shaped trough, the width of which is only slightly greater than the longest letter in a stack to be separated, is mounted on the framework below the pick-up arm and is inclined to the vertical at an angle of 30°, its longitudinal axis coinciding substantially with that of the pick-up arm. The top end of the trough is open and the open side of the trough faces outwardly to facilitate placing a stack of letters on a movable platform supported transversely across the trough. The letters in the stack are previously arranged so that their addressed faces are uppermost. The bottom of the trough has a central slot extending almost throughout its length and one limb of a double right angled bracket extends through the head into the trough to provide an attachment for the platform. The other limb extends rearwardly of the trough and is attached to a cylindrical nut which is threaded on a lead screw mounted parallel to the trough and of about the same length as the trough. The lead screw is rotated by an electric motor mounted on the framework and when the motor is driven, the nut on the lead screw is constrained to travel up or down, depending on the direction of rotation of the motor, and carries the platform with it.

The rear edge of the platform has attached to it the lower end of a band of cloth which forms a back aligning rest for the stack of letters placed on the platform. The upper end of the cloth band is wound around a spring loaded roller in the manner of a blind so that as the platform is raised, the band is wound on its roller. The band is provided because otherwise friction between the rear edges of letters in the stack and the bottom of the trough is liable to cause tilting of the letters about their longitudinal axes which may result in an edge of a letter, instead of its face, being presented to the suction head.

At the top of the trough an optical system is arranged to project a flat ribbon of light

across the trough in the path of the letters and the ribbon of light falls on a photoelectric cell connected in an amplifier circuit for energising a relay which controls the circuit of the electric motor driving the lead screw.

An arrangement of air jets is also provided at the top of the trough for the purpose of projecting towards the ends of the letters at the top of the stack a stream of air which causes the top letter to be at least partially airborne and so to separate it from the next letter. Any tendency towards the picking up by the suction head of more than one letter at a time is thus reduced or eliminated.

In operation of the apparatus described, assuming a stack of letters has been placed on the platform, the motor driving the latter is started by a push button switch mounted for convenience near the bottom of the trough. It will be assumed further that the pick-up arm has been set in motion, that the exhaust pump is running and that the photoelectric cell and air jet systems are operating.

When the top letter intercepts the light beam, the photoelectric cell amplifier releases the relay to switch off the platform driving motor and the raising of the stack ceases. The top letter is simultaneously rendered partially airborne by the air jets so that on the downward movement of the pick-up arm and contact of the suction head with the top letter, the latter is readily picked up by the suction head and is retained thereby during the subsequent upward and rearward traverse of the pick-up arm. The letter is thus carried to the rest position. On commencement of the next cycle of movement of the pick-up arm and as previously indicated, the letter is withdrawn from the suction head by the snatch rollers and disposed of thereafter in any desired manner. In particular applications of the apparatus described the separated letters are passed to the viewing position of a coding operator prior to automatic sorting.

The removal of the top letter by the pick-up arm allows the light beam which was intercepted by the top letter to impinge again upon the photoelectric cell so as to effect completion of the circuit of the platform driving motor with the result that the platform is again raised until the following letter intercepts the light beam with resultant repeated cessation of the drive.

When all the letters in a stack have been removed by the pick-up arm and the platform has reached the top of its travel, a limit switch is operated by the lead screw nut which effects reversal of the driving motor connections with the result that the platform is positively driven down the trough. At the lower limit of the platform, the lead screw nut operates a second limit switch which breaks the motor circuit and also restores the connections for upward travel of the platform when the motor circuit is next completed. The motor

drive will not now commence until the press button switch has again been operated and this may be done by the person who reloads the trough with a fresh stack of letters to be separated.

5 The collapsible nature of the suction head provides a degree of flexibility in the effective length of the pick-up arm. Thus if the top letter, or that portion of it with which the suction head comes into contact, is below the optimum position but not more than the depth of the suction head below that position, the suction head is driven down onto the letter. If on the other hand, the letter is at the optimum level, the bellows collapse on continued downward movement of the pick-up arm and so prevents the stack from being compressed appreciably. This collapsing is brought about by the hole in the lower cheek of the suction head becoming sealed by the face of the letter, resulting in a decrease of pressure inside the bellows. The air jets are thus enabled to fulfil their function of preventing the formation of any residual vacuum between the top letter and that immediately adjacent it, or alternatively to break any vacuum as soon as it forms.

Reference has been made earlier to the turning up of the forward end of the lower cheek of the suction head and this construction is adopted because, when a stack of letters includes envelopes of the window type for example, it has been found that the suction head may be operative upon the contents of the envelope exposed through the window and not upon the envelope itself. In consequence, when the letter is withdrawn by the snatch rollers the edge of the window is apt, to be caught

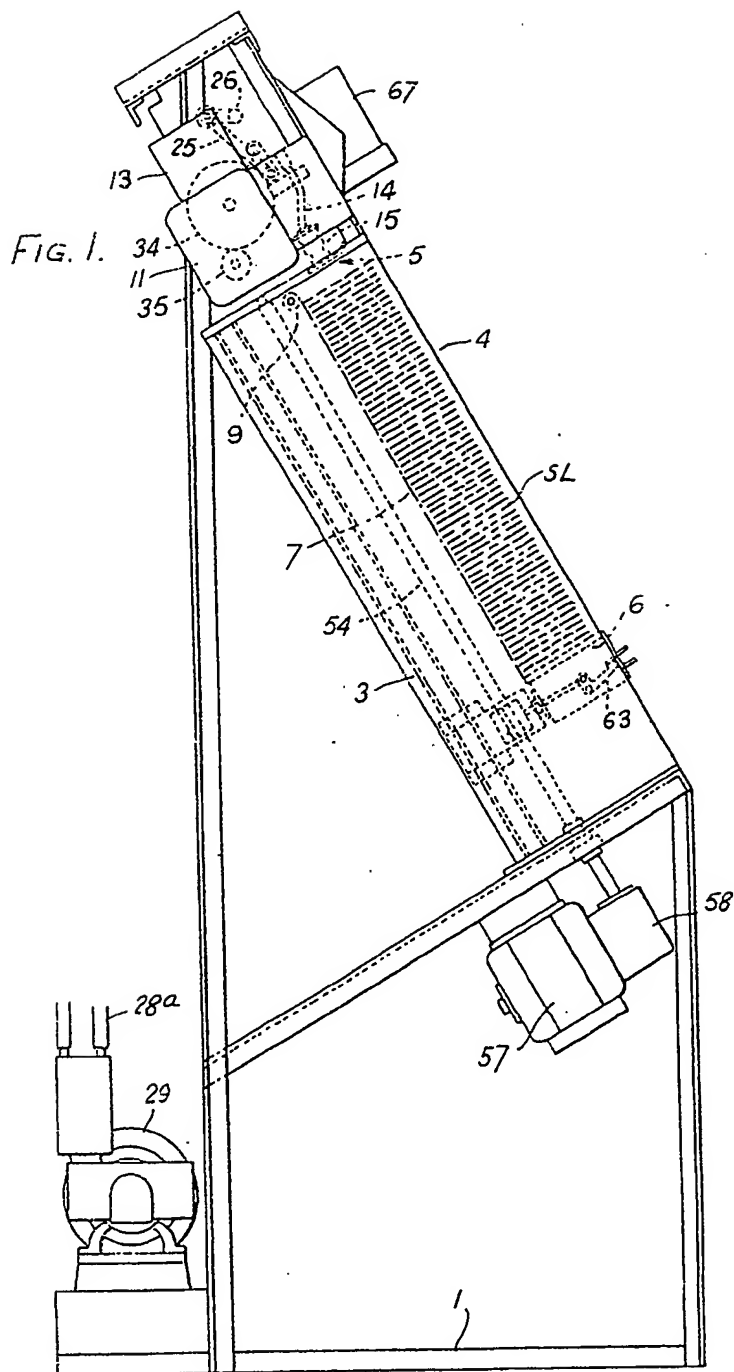
by the cheek of the suction head if the cheek is quite flat. Accordingly the front portion is turned up and the undesirable damage to letters and probable consequential interruption of the functions of the apparatus which may otherwise occur is avoided.

It will be understood that although particular forms of construction of the various component parts of the apparatus have been described modifications and alternative constructions within the scope of the invention may be adopted. Thus for example the means described for driving the letter platform may be modified by providing fixed independent guides for the platform and a releasable coupling between the lead screw and the nut to facilitate presetting the platform at any position in the trough. This facility would provide for a small stack of letters as the platform may be set to commence its movement from as near the top of the trough as may be desired. Again it will be appreciated that while a substantially vertical arrangement has been described, the invention is applicable to the separation of letters or other flat articles from a stack disposed otherwise than substantially vertically.

In one application of the apparatus described the pick up arm is set in operation through the solenoid operated clutch referred to, by an electrical impulse received every time the operator of a sorting equipment disposes of a letter.

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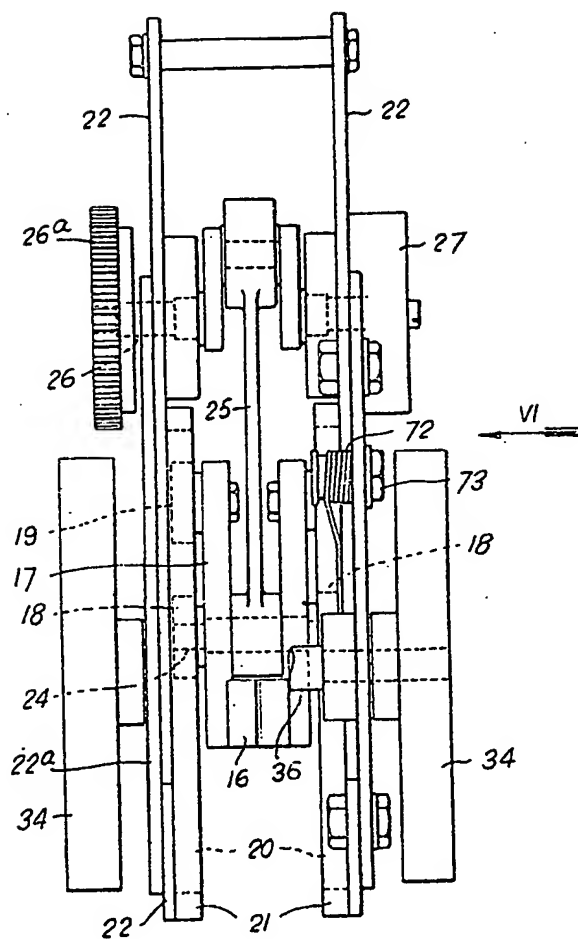
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4 SHEETS

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SHEET 1

FIG. 5.



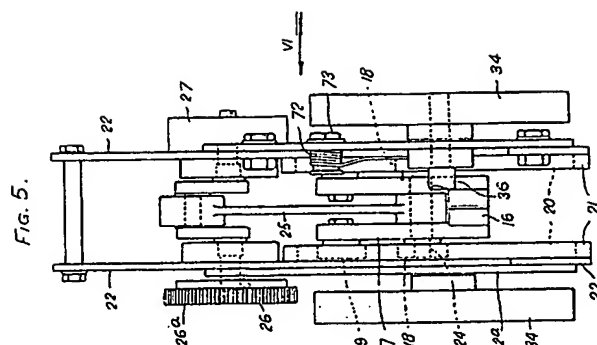
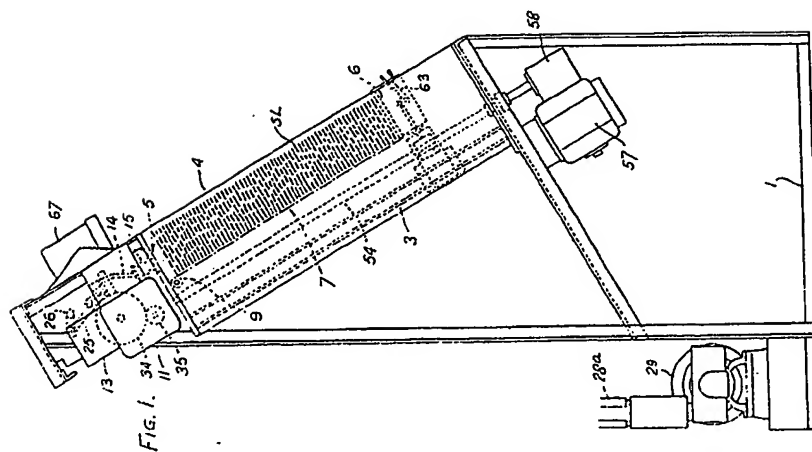
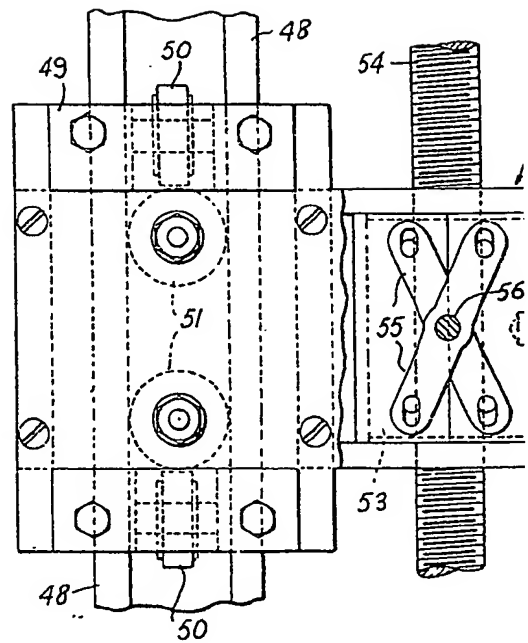
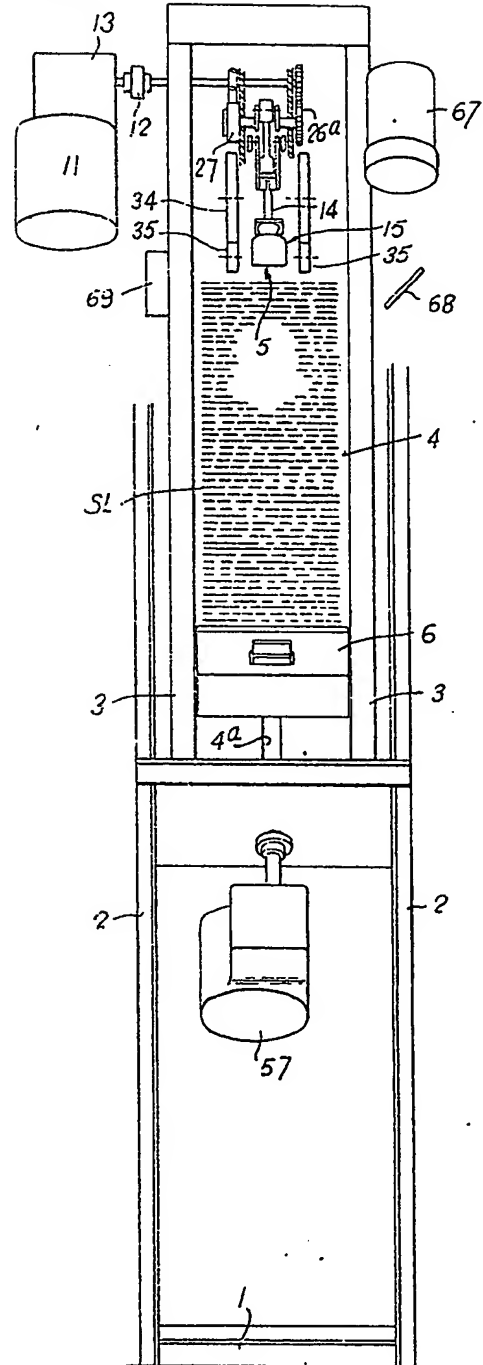
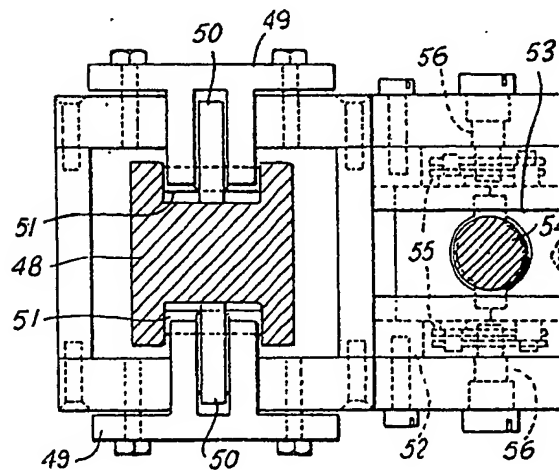


FIG. 2.



FIG



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SHEET 2

FIG. 3.

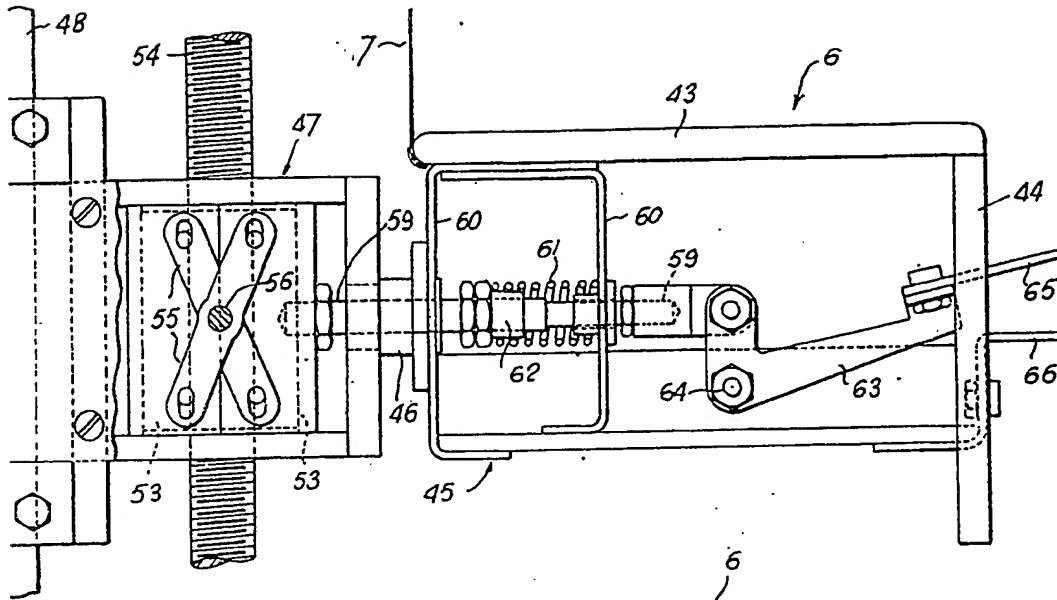
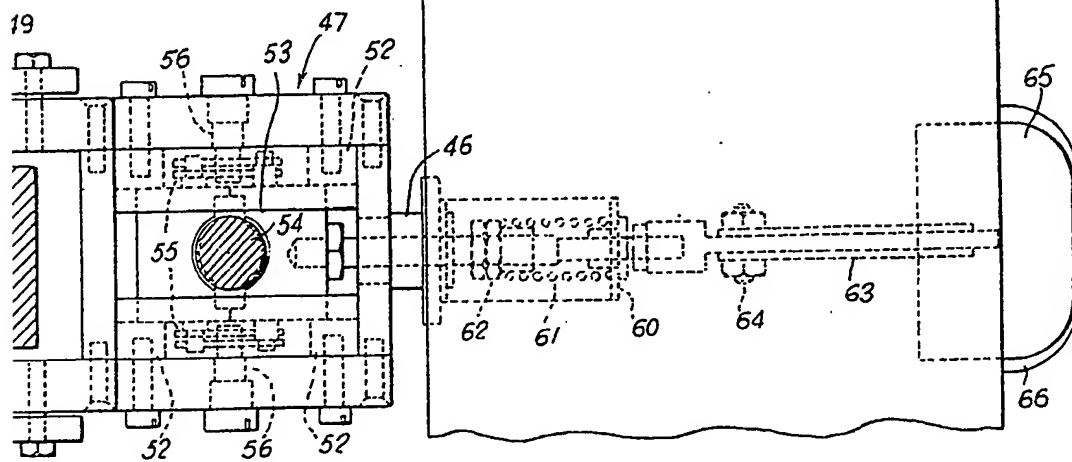


FIG. 4.





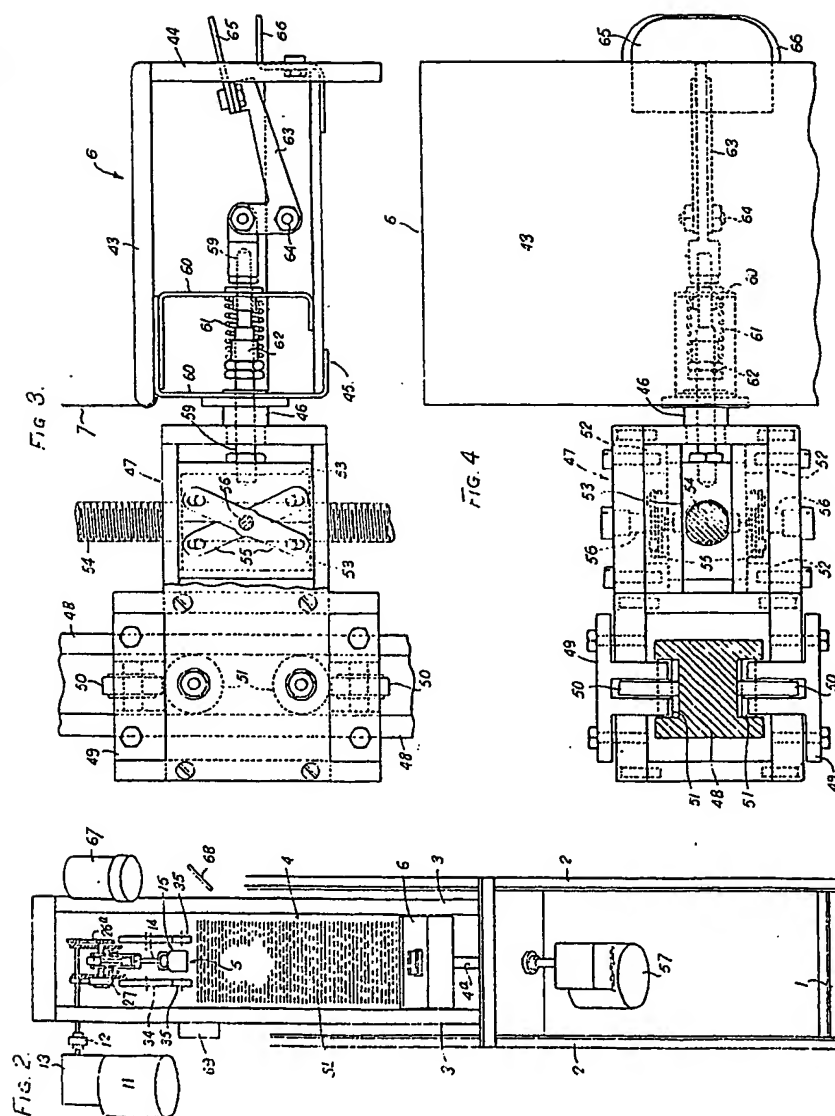
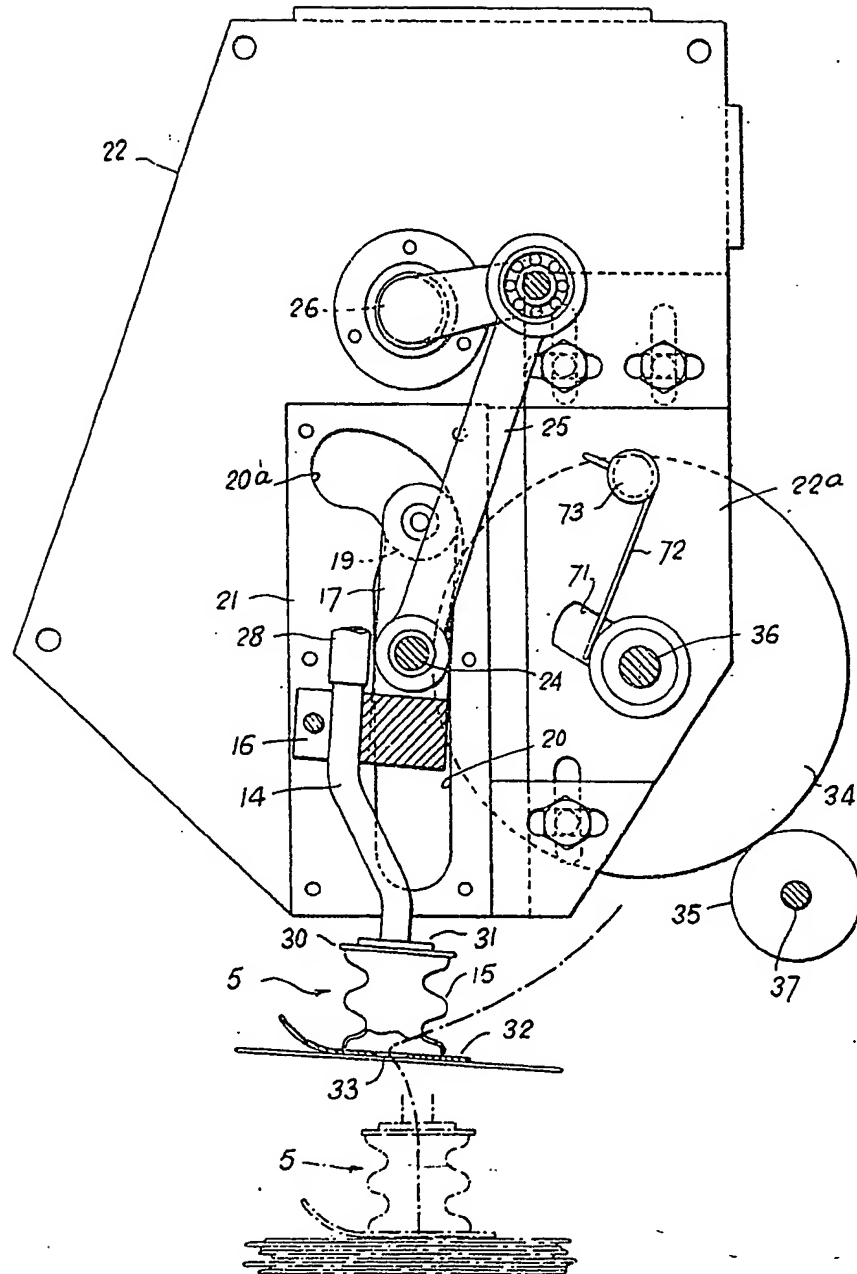


FIG. 6



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SHEET 3

FIG. 7.

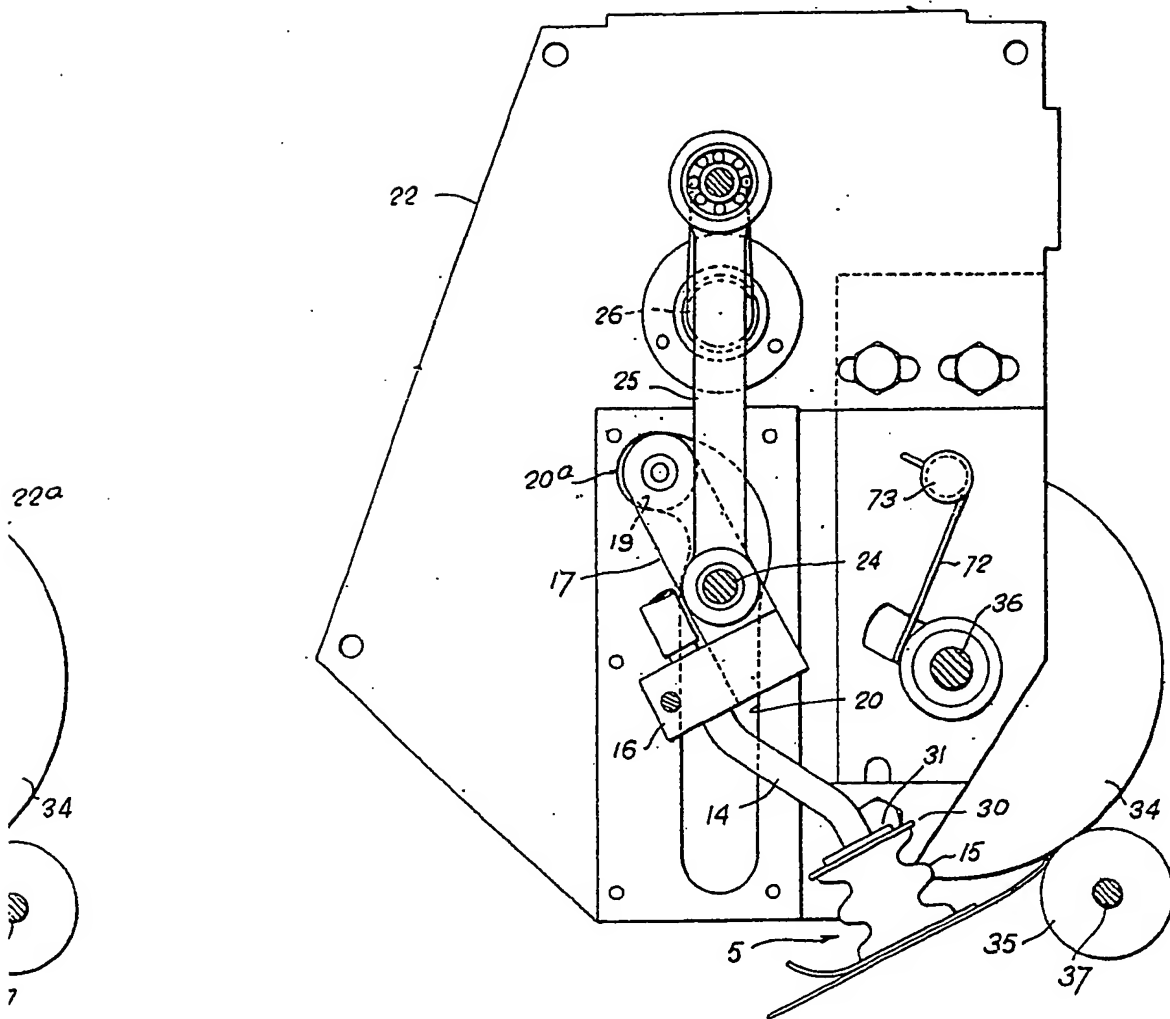


FIG 6

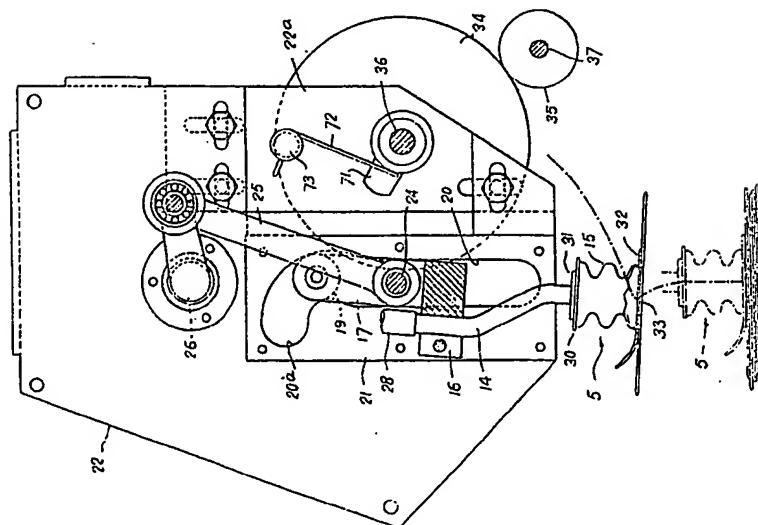
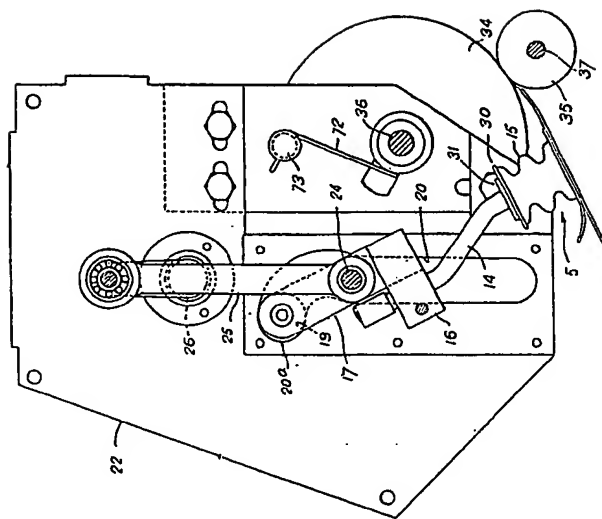


FIG. 7



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SHEET 4

FIG. 10

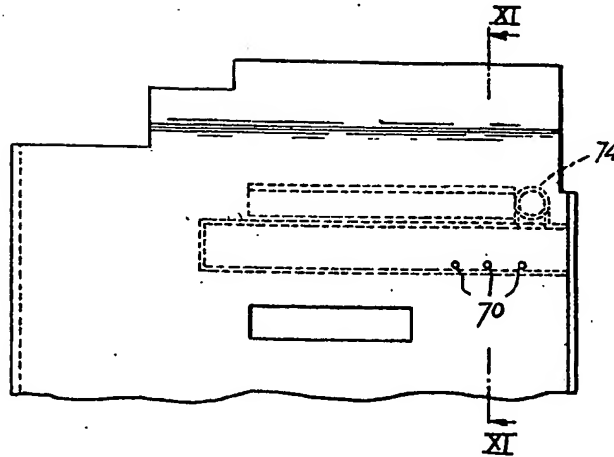


FIG. 8.

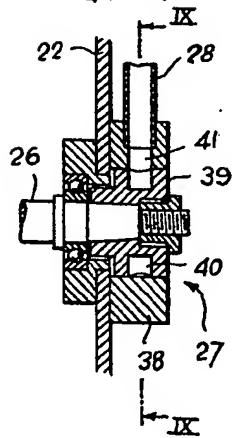


FIG. 9.

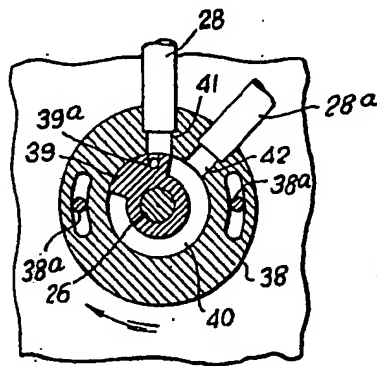


FIG. 11.

